Nutrient Management

Nutrient management means different things to different people

Personal

- Nutrition
- Weight

Urban/Suburban Residents

Healthy, attractive lawns

Golf courses

Parks

Animal Production

Hogs in confinement

Photo by IDNR

- Healthy animals
- Feed efficiency
- Net profits

Crop Production

Having the right nutrients available when needed - how much and when

Water Quality Protection

Insuring that waters are:

- “fishable”
- “swimmable”
- “drinkable”

Waterbodies and nutrients

- Nitrogen and phosphorus are the primary nutrients of concern
- N and P essential for life, a water without nutrients is a “dead” water
- Nutrient enrichment - “too much of a good thing.”

Why worry?

Nutrient Enrichment

Turkey River August 2001

Problems with nutrients

- Nuisance levels of algae and aquatic vegetation, toxic algae
- Low dissolved oxygen levels
- Imbalance of aquatic species
- Increased turbidity - sight feeding fish, aesthetics, water safety
- High nitrate levels in drinking water
- Formation of disinfection by-products (e.g., THMs) in drinking water

The national nutrient picture

- East Coast *pfisteria* issue
- Gulf hypoxia issue
- Drinking water - NO_3 and disinfection byproducts
- 2000 National WQ inventory
  - streams - 25% impaired by nutrients, agriculture leading cause of impairment
  - lakes and reservoirs - 50% impaired by nutrients, agriculture leading cause of impairment
  - overall picture has not changed appreciably over last decade

The national nutrient picture

- National Science and Technology Council - assessment of Gulf hypoxia - 1977
- Clinton/Gore Clean Water Action Plan - 1998
- Harmful Algal Bloom and Hypoxia Research and Control Act (PL 105-383) 1998
- All led to national strategy to develop nutrient criteria for waters
  - EPA to develop “guidance” values for nutrients for lakes, streams and wetlands, ecoregion based
  - states to adopt water quality standards for nutrients by end of ‘04

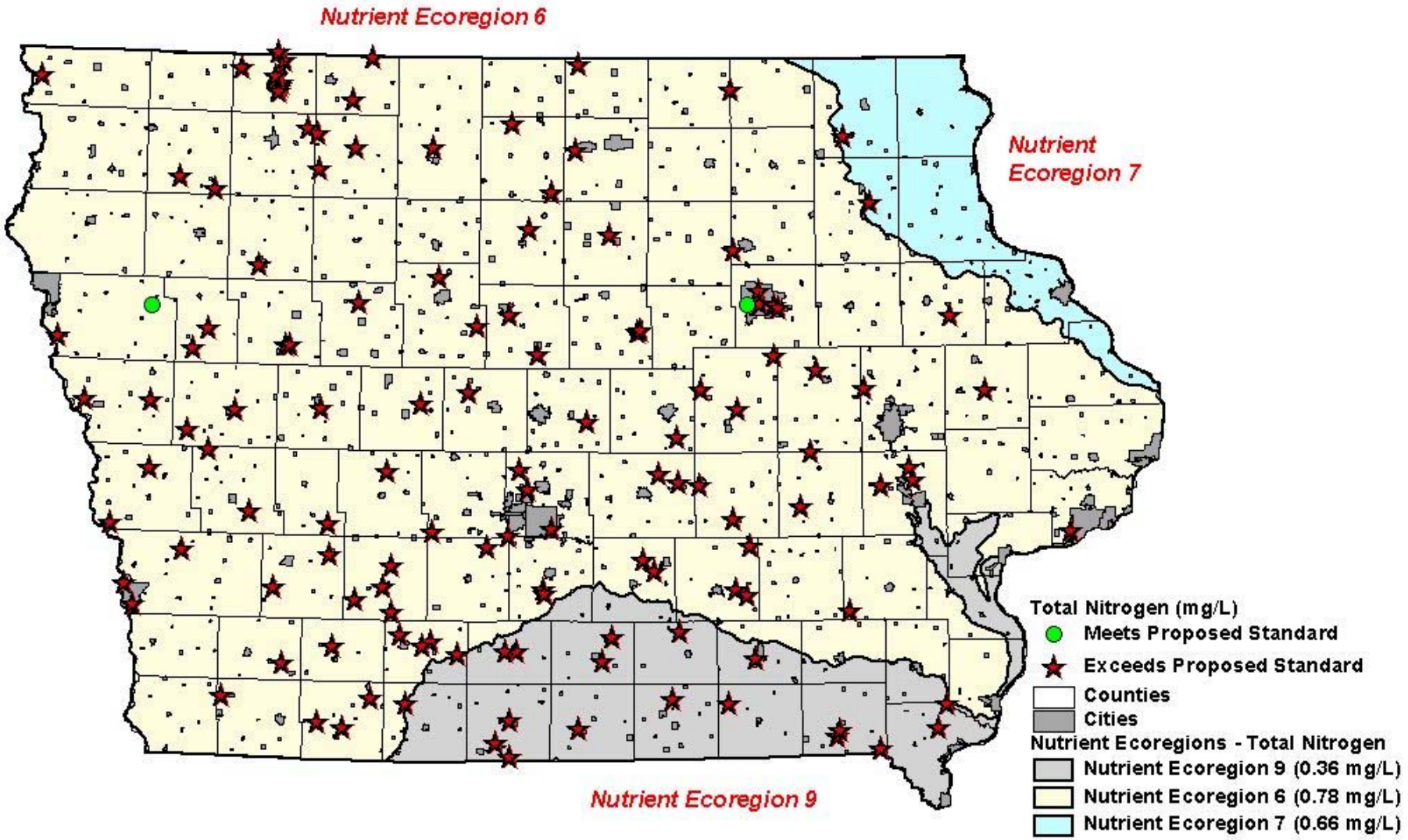
What are state water quality standards?

- Water quality standards define levels of water quality to achieve swimmable, fishable, drinkable waters.
- CWA requires states to adopt standards, EPA must approve
- EPA provides “guidance values” for states to use
  - one size does not fit all
  - states have some flexibility to deviate from guidance values
- EPA can adopt standards for a state if:
  - state fails to adopt standards
  - state-adopted standards are not adequate

Nutrient Water Quality Standards

- EPA has published guidance criteria for states to use in establishing nutrient water quality standards
- Total N, total P, chlorophyll a, and turbidity

Ambient Lake Data for 2000 and 2001 (all data)



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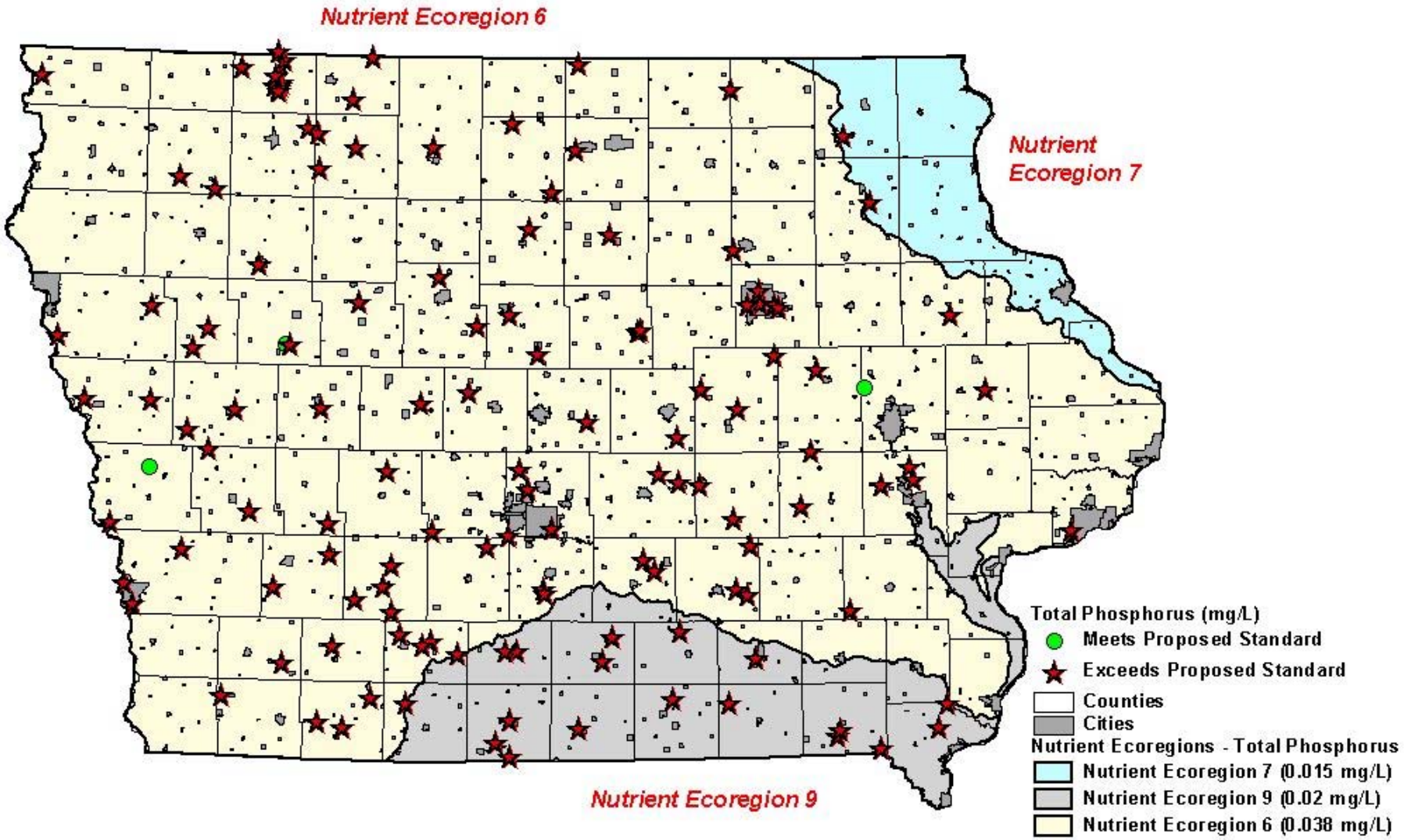
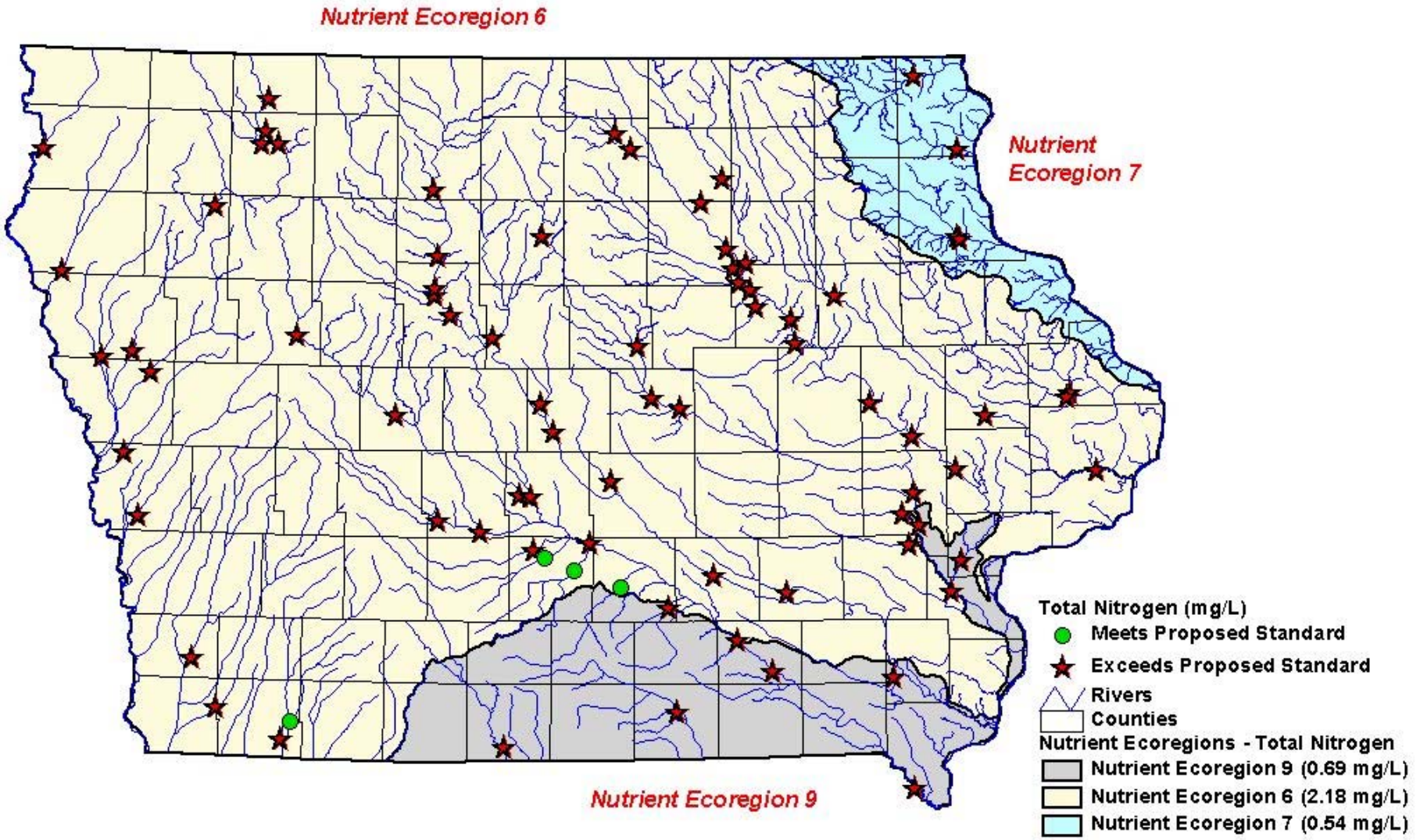


Ambient Stream Data for 2000 and 2001
(event and non-event data)



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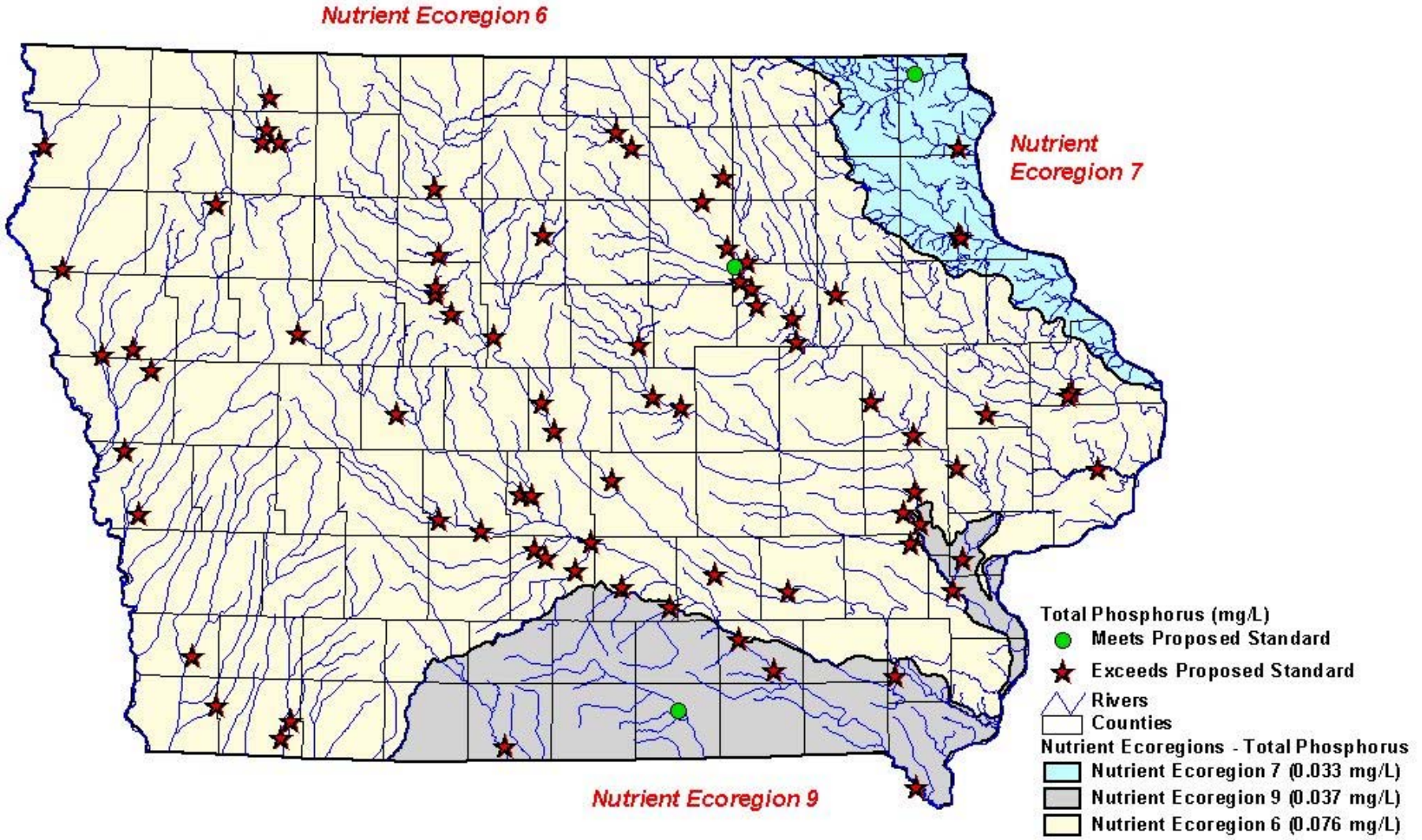
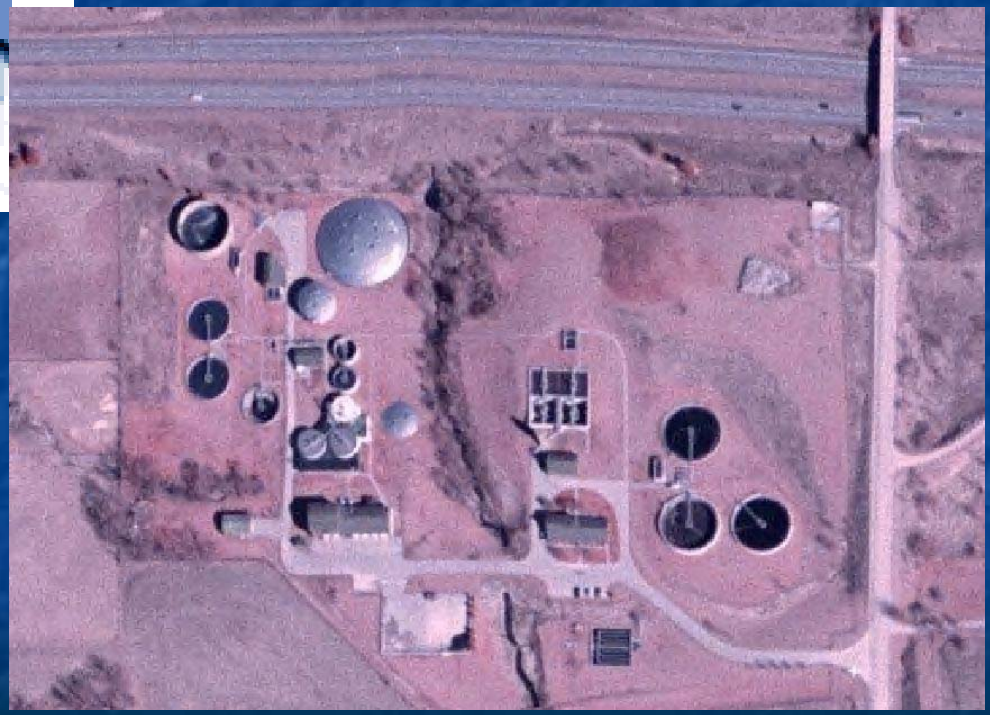
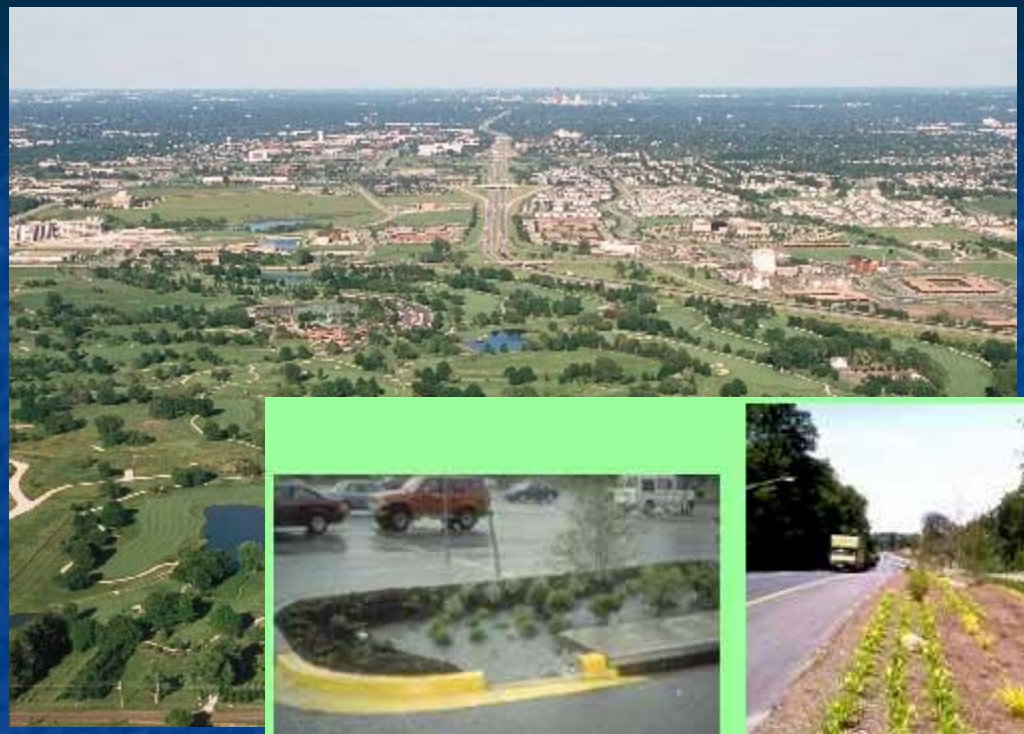


Can we significantly reduce the level of nutrients going into our waters?

To do so, we have to start thinking differently

Removal of N and P from wastewater effluent





Fertilizer managment

Stormwater Management

Manure Management

Consider both N and P

- Field application
- Erosion/runoff
- Drainage

Nutrient Standards for Waterbodies - two questions:

- What should the nutrient water quality standards be for Iowa?
- How can Iowa meet those standards?

Iowa does not have a comprehensive, statewide nutrient management strategy that will answer those questions

What we do have is “bits and pieces”

- Erosion control practices
- Agronomic nutrient research and education - how much do you need? Message: applying more than you need reduces net profits.
- Nutrient management task force (‘91 and ‘00)
- Research projects (e.g., ADW Research Project)
- Manure management research, MMPs
- Phosphorus index
- Watershed/Section 319 projects with nutrient reduction goals (e.g., Upper Maquoketa)
- 2000 Water Initiative
- GIS-based watershed models

Have we succeeded in reducing nutrients in Iowa waters?

- Due to temporal variability and lack of historic monitoring data, difficult to measure successes.
- Mixed messages, different studies say different things

Keeny/DeLuca Study - 1993

- Comparison of NO_3 levels in Des Moines River, ‘45 vs. 80’s.
- Conclusion: NO_3 and P levels in DM river similar to 55 years ago.
- Problem: Limited historic data

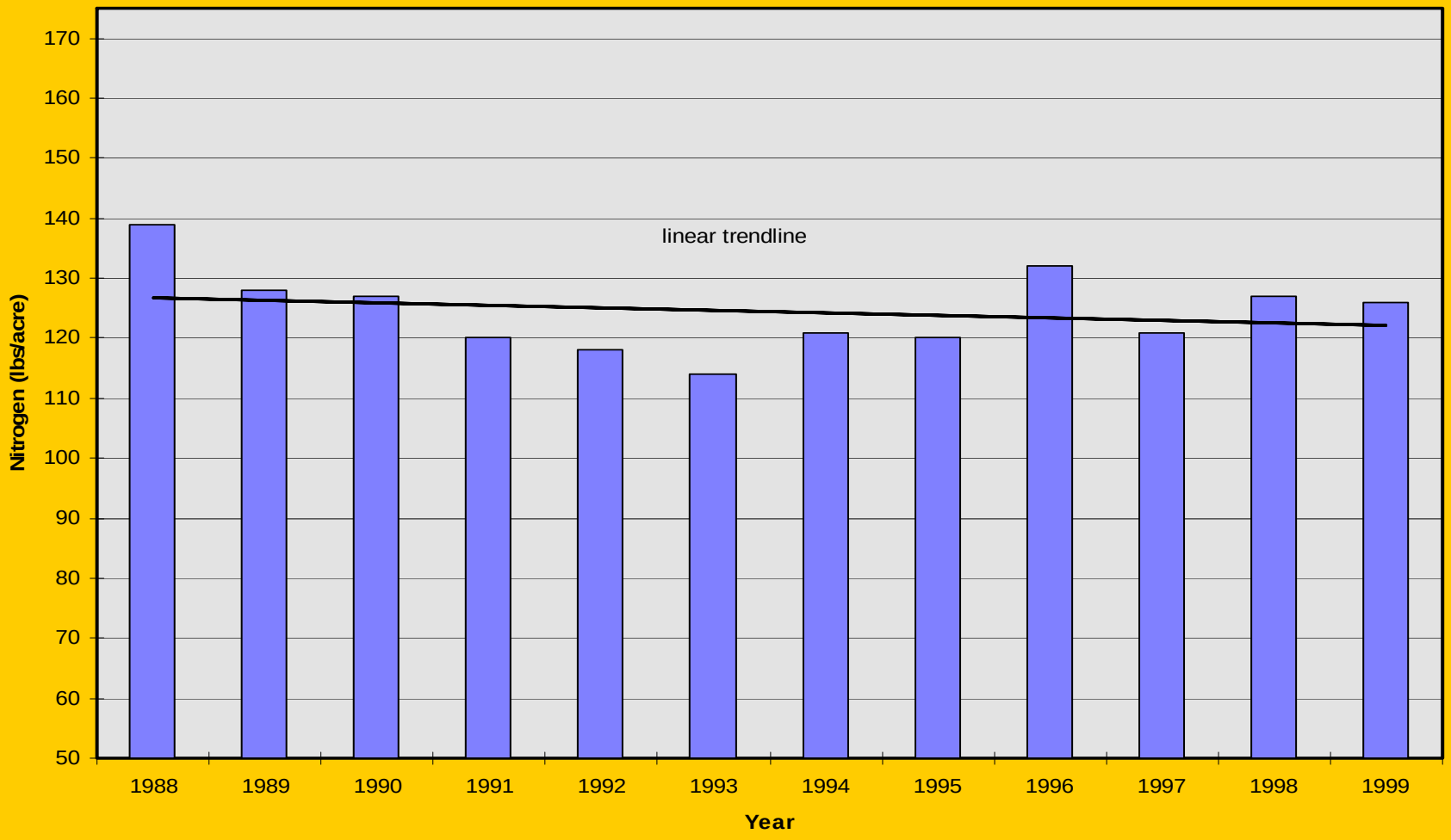
USGS - Eastern Iowa Basins - 1999

- Analyzed 1970 - 1995 data, 17 sites
- Trend analysis of NH_3 , P and NO_3 mixed, some $\Uparrow$, some $\Downarrow$, some $\Leftrightarrow$. Generally - increasing NO_3 trend
- NPS (e.g., agriculture) large part of picture, but point sources cannot be ignored, especially during low flows

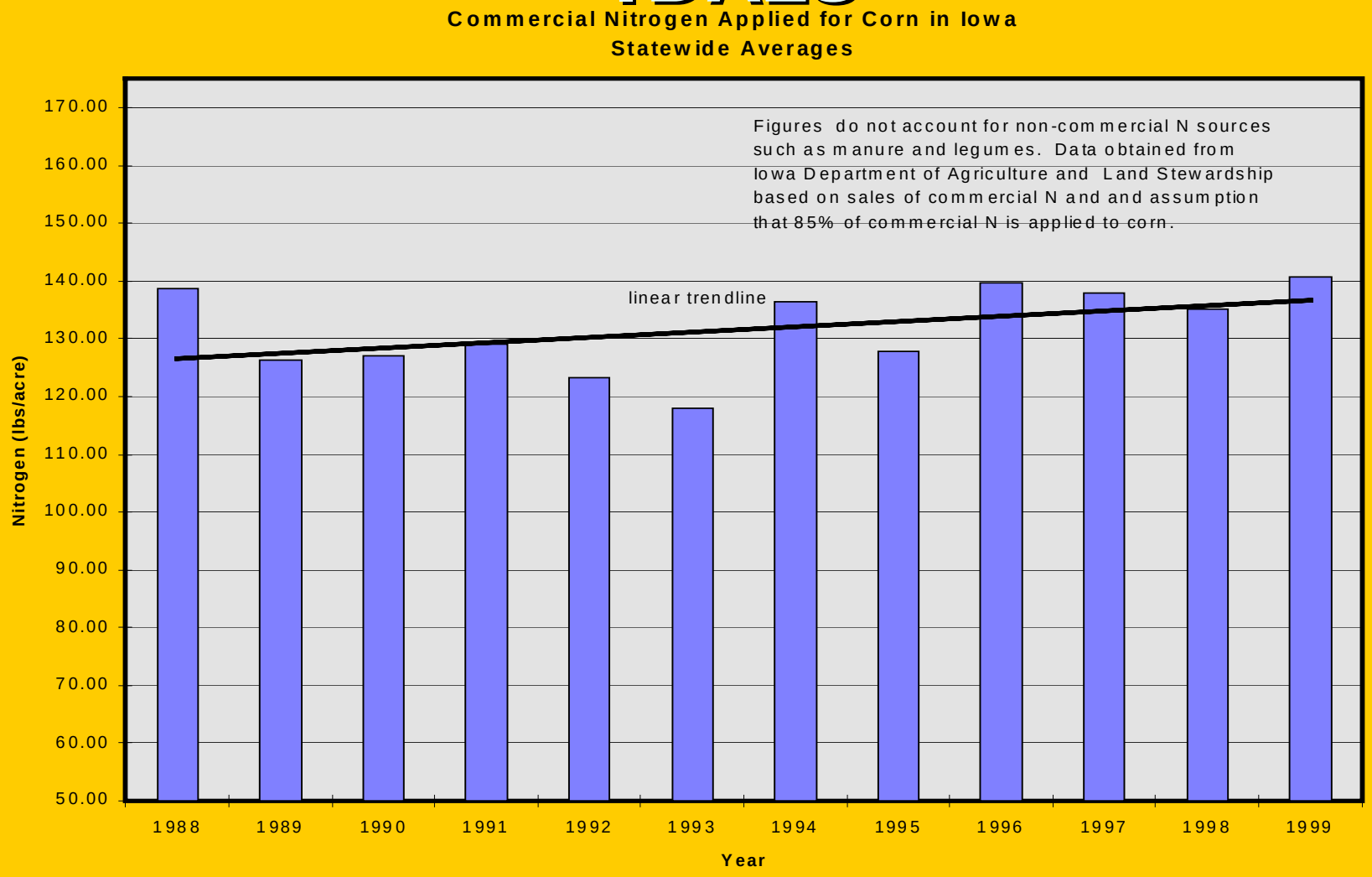
Nitrogen Use Research

- General findings
  - the less N applied, the less there will be in the water
  - applying excess nitrogen is money down the drain (less profit)
- Many factors influence NO_3 leaching
  - Application rate and timing
  - Drainage (e.g. tiles)
  - Rainfall
  - In-field management
- Nitrogen application rate and timing still a key variable

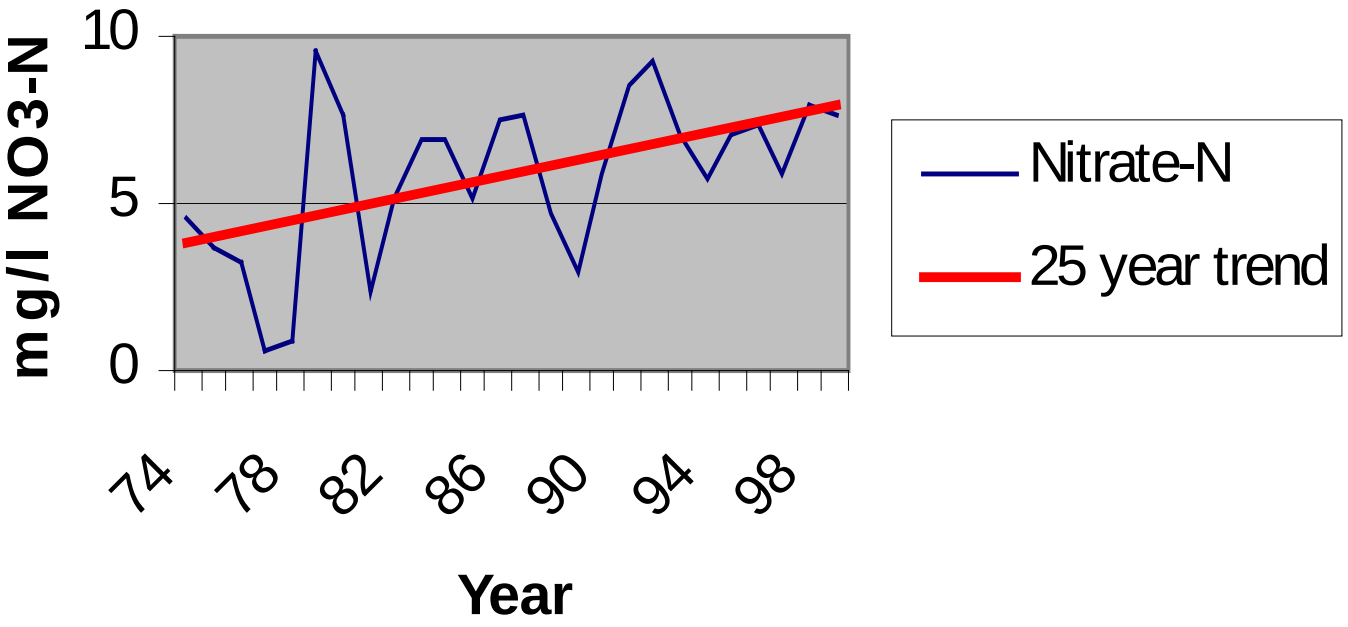
Nitrogen applied to corn - ISU



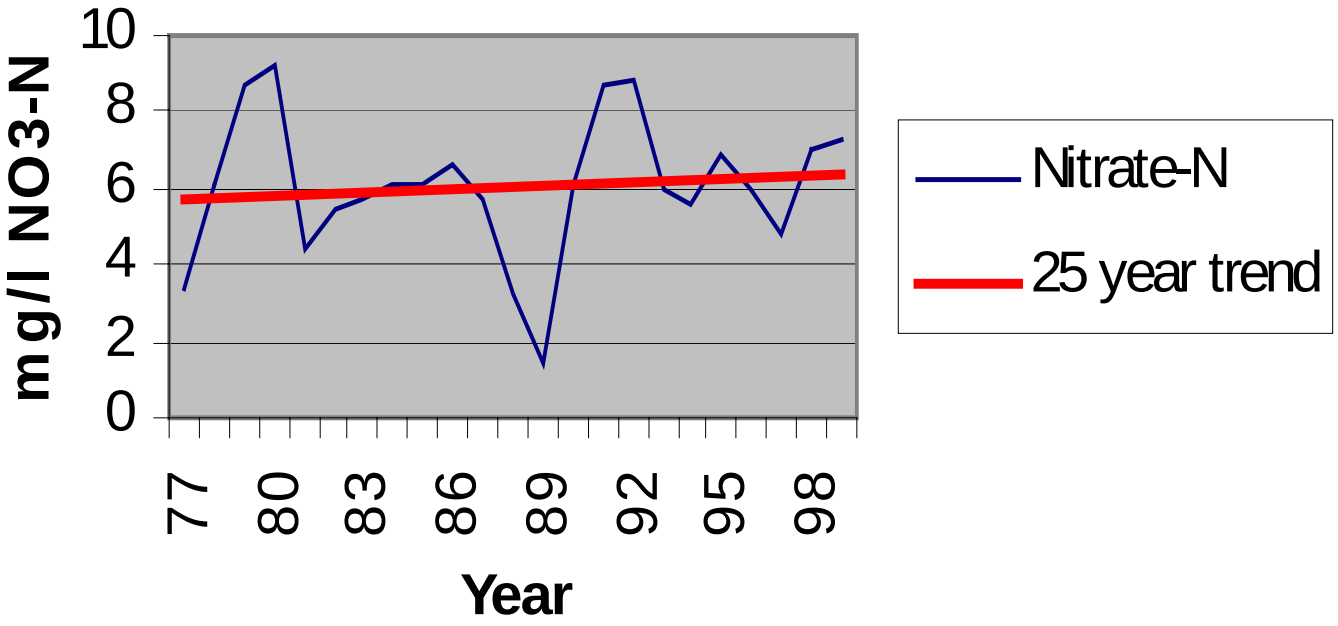
Commercial Nitrogen Sales - IDALS



Annual Average for Raccoon River



Annual Average for Des Moines River



IDNR - GSB analysis

- Looked at NO_3 flux in Iowa-Cedar basin
- Data sets: ‘45 - ‘51, post ‘70s
- Appears to be 2X to 3X increase in NO_3 flux from ‘40s to present.

Have we succeeded in reducing level of nutrients in Iowa waters?

- No clear picture of NO_3 trends, but my sense is:
  - increase from pre-commercial fertilizer years
  - NO_3 trend is indicative of total N trend
  - level of NO_3 in water function of many variables
- P concentration and flux may be decreasing
  - likely due to reduction in sediment delivery, but no good historical or contemporary sediment transport data
- NPSs responsible for large part of total N load, PSs need to be considered in low-flow conditions

Why haven’t we been more successful in reducing nutrient levels in our waters?

ISU Research

- Common to get 50 bu/ac yield increase with 150 lb/ac fertilizer - return of about $125 for investment of $40.
- 10% yield reduction could result in 50% income reduction
- Improving N management to save 1/3 of the 25 lbs/acre N loss would only save the producer $2/acre

Specific questions we must answer:

- What are the appropriate nutrient water quality standards for Iowa?
  - EPA “ideal” values or something higher and more realistic?
  - Mean, median, peak, flow weighted average?
- How much N and P and from where?
  - Point sources versus nonpoint sources
  - Agriculture versus urban and wastewater plants
- Can we achieve significant nutrient reduction without significant economic impacts?
- How much “bang for the buck” will we get if we significantly reduce nutrient levels in our waters?

A statewide nutrient strategy

4 elements

- Nutrient budget for the state
  - look at all sources - ag, urban, wastewater, rainfall/air deposition, mineralization of organic matter
  - develop GIS-based watershed nutrient model
- Evaluate effectiveness of nutrient control practices - will they get us to where we want to go?
  - in-field nutrient management, including manure management
  - best management practices, e.g, contours, buffers
  - constructed wetlands
  - nutrient removal from domestic/industrial wastewater

A statewide nutrient strategy

4 elements

- Nutrient water quality standards - what are reasonable standards?
- Putting it all together
  - scientifically valid picture of nutrients in Iowa
  - realistic expectations
  - recommendations for achieving reductions
    - more of the same (traditional), or
    - new approaches?